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Ann Marie Alaniz
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Attached are the following pages:
- Summary of Telephone Interview with Examiner [3 pages]; and
- One (1) non-patent literature reference [25 pages].

Applicant:	OTTO, et al.	**Group Art Unit:**	1764
Serial No.:	10/792,056	**Examiner:**	Ellen M. McAvoy
Filing Date:	03/03/2004	**Atty. Docket No.:**	154-28553-US
Title:	Method for Lubricating and/or Reducing Corrosion of Drilling Equipment		

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	**OTTO, et al.**	§	**Group Art Unit:**	**1764**
Serial No.:	**10/792,056**	§	**Examiner:**	**Ellen M. McAvoy**
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Summary of Telephone Interview with Examiner Held July 21, 2008

Applicant appreciates the examiner's time and input during a telephone interview in this case on July 21, 2008. The following is a summary of the substance of the interview.

During the interview, Applicant explained to the examiner that the use of fatty acid soaps in drilling fluids to blue metal equipment is not new, but that the typical fatty acid soaps used in drilling fluids comprise multivalent metals, or metals having a valence of greater than 1. Applicant explained that the use of acrylamide polymers in drilling fluids is relatively new, and that drilling fluids experience uncontrollable viscosification at high temperatures when the acrylamide monomers are used in drilling fluids comprising multivalent fatty acid soaps. The inventors in the present application suggested that the use of fatty acid soaps with metals having a lower valence might solve the problem. The inventors did not know whether the lower valence fatty acid salts would also cause uncontrollable viscosification, thereby preventing effective bluing of the drilling equipment.

Applicant argued that the examiner has not pointed to a teaching or suggestion of this problem in the references, and that the examiner has not pointed to a teaching or suggestion of the claimed solution to the problem in the references. Applicant argued that these features were part of the invention "as a whole," and that the examiner had the burden to point to a teaching or suggestion of these features of the invention in order to establish a case of *prima facie* obvious under 35 U.S.C. § 103.

Applicant pointed out that Clark describes fatty acids as possible components to form an oil phase—particularly an internal oil phase. The examiner said that Clark's fluid did not necessarily have to be an oil-in-water emulsion. However, Applicant pointed out that the context in which the natural fatty acids were described in Clark was "as" the oil phase.

Referring to col. 3 of Clark, Applicant pointed out that Clark was trying to provide an oil phase comprising an otherwise toxic sulfurized alcohol in an alcohol in order to render the sulfurized alcohol non-toxic. Applicant argued out that there was no motivation to select insoluble alkali metal fatty acids to form this oil phase because the use of insoluble fatty acid soap particles would change the principle of operation of Clark and/or render Clark unsatisfactory for its intended purpose. MPEP 2143.02 V. and VI.

The examiner asked whether Applicant was claiming insoluble fatty acid soap particles in any continuous phase, whether oil or water. Applicant confirmed that this was the case.

The examiner said that there must be evidence of record that the fatty acid soap particles are insoluble. Applicant confirmed that she would submit a reference related to the solubility of at least lithium sulfate in a variety of solvents. See C. A. Jacobson, et al. Solubility Data for Various Salts of Lauric, Myristic, Palmitic, and Stearic Acids. *The Journal of Biological Chemistry.* (1916) 29-53 (copy attached). Applicant also pointed out that Applicants are claiming the use of a drilling fluid comprising insoluble fatty acid soap particles.

The examiner argued that the claims are broader than our discussions, and maintained that she has established a case of *prima facie* obviousness of the pending claims, as written. The examiner then suggested that Applicant provide evidence that the

fatty acid soaps of the metals described in Clark produce viscosity problems that are not produced by the claimed alkali metal fatty acid soaps.

Respectfully submitted,

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The Journal of Biological Chemistry

SOLUBILITY DATA FOR VARIOUS SALTS OF LAURIC, MYRISTIC, PALMITIC, AND STEARIC ACIDS.*

By C. A. JACOBSON and AUGUST HOLMES.

(From the Department of Chemistry, University of Nevada, Reno.)

(Received for publication, March 15, 1916.)

The isolation of individual members of the higher saturated fatty acids, when occurring in mixtures of such acids, has always been fraught with considerable, if not insurmountable difficulties.

The authors, in their characterization of the constituents of alfalfa seed oil,[1] were confronted with the same difficulties. After applying all the known methods that were available for these separations, and finding that unsatisfactory results were obtained in every case when artificially prepared mixtures of the fatty acids were employed, it was decided to investigate the solubilities of various salts of lauric, myristic, palmitic, and stearic acids in a number of organic solvents as well as in water.

It was hoped that the solubility data thus obtained would furnish the means for a scheme of separation of the different acids, but just how far these anticipations were realized will be discussed in another paper.

The property of solubility has furnished the basis for more systems of separation of chemical substances than any other, although differences of melting point, boiling point, and volatilization in steam are properties upon which schemes of separation have been founded.

The following tables include the solubility of the lithium, magnesium, beryllium, barium, lead, and silver salts of lauric, myristic, palmitic, and stearic acids in two or more of the following solvents: water, ethyl and methyl alcohol, ether, benzene, ethyl acetate, methyl acetate, amyl alcohol, amyl acetate, chloro-

* This investigation was carried out at the Nevada Agricultural Experiment Station with funds obtained under the Adams Act.

[1] Jacobson, C. A., and Holmes, A., *J. Am. Chem. Soc.*, 1916, xxxviii, 480.

form, and acetone, at room temperature, 25°, 35°, and 50°, whenever the boiling point of the solvent permitted.

The solvents were selected according to their most probable applicability along this line. They were of the highest purity obtainable and always redistilled whenever any question as to their purity arose. In general the salts of the fatty acids were made from the acetates of the metals, but a detailed description of the preparation of each salt will be given in connection with its table of solubilities.

An excess of the salt to be investigated was put into a 100 cc. round bottom flask having a neck about 5 inches long. Four such flasks were used at the same time for the four different salts of a given metal and the flasks filled nearly full with the solvent to be employed. The flasks were then stoppered and clamped in a shaking device, which was so arranged that the flasks, excepting the upper part of the necks, were immersed in a bath of water whose temperature was kept constant to within 0.5°. An electric motor was used for shaking the flasks in the water bath and the agitation continued for 2 hours after the liquid in the flasks had assumed the temperature of the water in the bath. The shaking was then interrupted and the suspended matter allowed to settle, after which about 10 cc. of the solution were rapidly drawn off with a carefully calibrated pipette, the solution was weighed in a covered weighing tube, and finally the solvent evaporated off. From the weight of the residue in the weighing tubes the solubility was calculated in terms of gm. of salt, soluble in 100 gm. of solvent.

We did not attempt to obtain absolute solubilities in any case, although most of the data here submitted will approach the absolute values very closely. It has been learned that in some instances a 6 hour shaking in contact with the solvent is not sufficient to secure maximum solubility, but for the solvents used the difference between the solubility after 2 and 6 hours' shaking is so slight that for all practical purposes it may be neglected. Amyl alcohol may be considered an exception to this rule for it was found that a 2 hour shaking in most cases did not suffice to produce a saturated solution. The results recorded under this solvent are those obtained after 2 hours' shaking, making them comparable with those of the other salts.

In the first table will be found the results of analyses of the four fatty acids and their salts which were employed in obtaining the following solubility data.

TABLE I.

	Lauric acid.	Myristic acid.	Palmitic acid.	Stearic acid.
M. p. found	43.0°	49.7°	61.4°	69 0°
M. p. given	43.6°	53.8°	62.0°	69.2°
Neutralization value found	280 0	228.5	220.4	199.3
Neutralization value calculated	280.5	246.1	219.1	197.5
M. p. Li salt	229.2–229.8°	223.6–224.2°	224–225°	220.5–221.5°
Per cent of Li in Li salt found	3.44	2.91	2.58	2.88
Per cent of Li calculated	3.48	2.99	2.66	2.41
M. p. Mg salt	150.4°	131.6°	121–122°	132°
Per cent of Mg in Mg salt found	5.73	5.09	4.51	4.20
Per cent of Mg calculated	5.75	5.08	4.54	4.11
M. p. Pb salt	104.6–104.8°	108.6–108.8°	112.2–112.4°	115.6–115.8°
Per cent of Pb in Pb salt found	33.66	31.01	28.24	26.50
Per cent of Pb calculated	34.23	31.31	28.88	26.77
Per cent of Ba in Ba salt found	25.82	24.20	21.62	19.60
Per cent of Ba calculated	25.64	23.22	21.20	19.52
M. p. Ag salt	212–213°	211°	209°	205°
Per cent of Ag in Ag salt found	34.78	32.45	29.74	28.05
Per cent of Ag calculated	35.12	32.20	29.72	27.58

In Table II will be found the analyses of the beryllium salts of the four fatty acids which were prepared in the following manner: To 10 gm. of the acid dissolved in 95 per cent alcohol (the solution neutralized with alcoholic ammonium hydroxide, using litmus as the indicator), a calculated amount of beryllium nitrate dissolved in alcohol was added. The resulting precipitate was

washed several times with boiling alcohol, both by decantation and in a filter, then dried and subjected to analysis with the following results.

TABLE II.

	Be laurate.	Be myristate.	Be palmitate.	Be stearate.
Per cent of Be found	3.71	3.48	3.08	2.81
Calculated for Be $(Ac)_2$	2.23	1.96	1.75	1.58
Ratio: $\frac{\text{Found}}{\text{Calculated}}$	1.66	1.77	1.76	1.78
Hence, calculated for Be(OH)Ac.	4.04	3.59	3.23	2.87
Per cent of C found	63.85	66.19	67.95	70.17
Calculated for Be(OH)Ac	63.91	66.33	68.23	69.81
Per cent of H found	10.93	10.90	11.53	11.91
Calculated for Be(OH)Ac	10.74	11.13	11.48	11.73

The above results show that the basic salts of beryllium with the formula Be(OH)Ac were obtained rather than the normal $Be(Ac)_2$ salts. They were found to be only very slightly soluble in the general organic solvents, but for the sake of completeness their solubilities were determined in ethyl and methyl alcohol at 25°. Table III contains these data.

TABLE III.

Solubility of Acid Salts of Beryllium at 25°.

	Laurate.	Myristate.	Palmitate.	Stearate.
Ethyl alcohol $\frac{\text{gm. salt}}{\text{100 gm. solvent}}$	0.004	0.004	0.004	..
Methyl alcohol $\frac{\text{gm. salt}}{\text{100 gm. solvent}}$	0.050	0.047	0.042	0.040

Table IV contains the solubility data for the lithium salts prepared by adding a calculated amount of lithium acetate to the alcoholic solutions of the respective fatty acids. The precipi-

tates formed were dissolved in boiling alcohol and the solutions allowed to stand over night in a cool place. The salts that had separated were washed and dried.

TABLE IV.

Solubility of Lithium Salts in Ethyl Alcohol (Absolute).

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
	Temperature 20°			
	gm.	gm.	gm.	gm.
Laurate	0.0313	7.79	7.76	0.403
Myristate	0.0147	7.57	7.55	0.194
Palmitate	0.0075	7.81	7.80	0.096
Stearate	0.0056	7.74	7.73	0.072
	Temperature 25.4°			
Laurate	0.0342	7.69	7.66	0.447
Myristate	0.0174	7.77	7.76	0.224
Palmitate	0.0092	7.80	7.79	0.118
Stearate	0.0060	7.78	7.78	0.069
	Temperature 35°			
Laurate	0.0418	7.69	7.65	0.546
Myristate	0.0215	7.74	7.72	0.278
Palmitate	0.0110	7.77	7.76	0.142
Stearate	0.0082	7.73	7.72	0.106
	Temperature 50°			
Laurate	0.0594	7.66	7.60	0.782
Myristate	0.0335	7.69	7.66	0.435
Palmitate	0.0190	7.64	7.61	0.248
Stearate	0.0154	7.69	7.67	0.200
	Temperature 65°			
Laurate	0.0827	7.28	7.20	1.149
Myristate	0.0490	7.38	7.33	0.669
Palmitate	0.0306	7.85	7.82	0.391
Stearate	0.0256	7.72	7.69	0.333

The solubilities here recorded are practically the absolute solubilities of the salts used, if the results of Partheil and Ferié[1] can be taken to represent absolute solubilities.

TABLE V.

Solubility of Lithium Salts in Methyl Alcohol.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 15.2°				
	gm.	gm.	gm.	gm.
Laurate	0.2442	7.97	7.73	3.159
Myristate	0.1055	7.95	7.84	1.346
Palmitate	0.0486	7.94	7.89	0.616
Stearate	0.0321	9.23	9.20	0.349
Temperature 25°				
Laurate	0.2883	7.93	7.64	3.773
Myristate	0.1299	7.86	7.73	1.680
Palmitate	0.0604	7.89	7.83	0.771
Stearate	0.0344	7.85	7.82	0.439
Temperature 34.6°				
Laurate	0.3463	7.88	7.53	4.597
Myristate	0.1684	7.85	7.68	2.193
Palmitate	0.0850	7.82	7.83	1.086
Stearate	0.0513	7.84	7.79	0.658
Temperature 50°				
Laurate	0.4487	7.82	7.87	6.088
Myristate	0.2329	7.49	7.25	3.281
Palmitate	0.1252	7.65	7.52	1.652
Stearate	0.0810	7.76	7.68	1.057

[1] Partheil, A., and Ferié, F., *Arch. Pharm.*, 1903, ccxli, 545.

TABLE VI.

Solubility of Lithium Salts in Water.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 16.3°				
	gm.	gm.	gm.	gm.
Laurate	0.0152	9.86	9.84	0.154
Myristate	0.0027	9.85	9.85	0.027
Palmitate	0.0010	9.84	9.84	0.010
Stearate	0.0009	9.86	9.86	0.009
Temperature 25°				
Laurate	0.0184	9.86	9.84	0.187
Myristate	0.0039	10.83	10.83	0.036
Palmitate	0.0015	9.85	9.85	0.015
Stearate	0.0010	9.83	9.83	0.010
Temperature 35°				
Laurate	0.0203	9.83	9.81	0.207
Myristate	0.0042	10.01	10.02	0.042
Palmitate	0.0015	9.83	9.82	0.015
Stearate	0.0010	9.12	9.12	0.010
Temperature 50°				
Laurate	0.0274	9.81	9.78	0.280
Myristate	0.0061	9.79	9.79	0.062
Palmitate	..	..	..	..
Stearate	..	..	..	..

TABLE VII.

Solubility of Lithium Salts in Ether.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 15.8°				
	gm.	gm.	gm.	gm.
Laurate	0.0008	7.20	7.20	0.011
Myristate	0.0009	7.00	7.00	0.013
Palmitate	0.0005	7.09	7.09	0.007
Stearate	0.0008	7.23	7.23	0.011
Temperature 25°				
Laurate	0.0005	7.98	7.98	0.006
Myristate	0.0003	7.73	7.73	0.004
Palmitate	0.0006	8.35	8.35	0.007
Stearate	0.0008	7.01	7.01	0.011

TABLE VIII.

Solubility of Lithium Salts in Amyl Alcohol.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 16°				
	gm.	gm.	gm.	gm.
Laurate	0.0058	7.92	7.92	0.073
Myristate	0.0024	8.21	8.21	0.029
Palmitate	0.0016	8.33	8.33	0.019
Stearate	0.0008	7.45	7.45	0.011
Temperature 25.7°				
Laurate	0.0081	7.29	7.28	0.111
Myristate	0.0036	7.74	7.74	0.046
Palmitate	0.0024	7.48	7.47	0.032
Stearate	0.0022	7.88	7.88	0.028
Temperature 35°				
Laurate	0.0101	8.03	8.02	0.126
Myristate	0.0052	8.33	8.33	0.062
Palmitate	0.0028	8.37	8.37	0.033
Stearate	0.0024	7.80	7.86	0.031
Temperature 49.2°				
Laurate	0.0173	8.54	8.53	0.203
Myristate	0.0079	7.22	7.21	0.109
Palmitate	0.0052	7.49	7.48	0.069
Stearate	0.0046	7.61	7.61	0.060

TABLE IX.

Solubility of Lithium Salts in Chloroform.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 15.2°				
	gm.	gm.	gm.	gm.
Laurate	0.0010	16.59	16.59	0.006
Myristate	0.0007	16.03	16.03	0.004
Palmitate	0.0006	15.60	15.60	0.004
Stearate	0.0007	16.37	16.37	0.004

TABLE X.

Solubility of Lithium Salts in Amyl Acetate.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 14.5°				
	gm.	*gm.*	*gm.*	*gm.*
Laurate	0.0056	8.23	8.23	0.068
Myristate	0.0031	8.40	8.40	0.037
Palmitate	0.0023	6.07	6.07	0.038
Stearate	0.0028	8.13	8.13	0.034
Temperature 25°				
Laurate	0.0052	8.07	8.07	0.064
Myristate	0.0028	8.31	8.31	0.034
Palmitate	0.0020	8.26	8.26	0.024
Stearate	0.0024	8.40	8.40	0.029
Temperature 35°				
Laurate	0.0049	8.02	8.02	0.061
Myristate	0.0037	8.42	8.42	0.044
Palmitate	0.0031	8.44	8.43	0.037
Stearate	0.0024	7.81	7.81	0.031
Temperature 50°				
Laurate	0.0052	8.58	8.57	0.061
Myristate	0.0038	8.53	8.52	0.045
Palmitate	0.0030	8.33	8.32	0.036
Stearate	0.0040	8.97	8.97	0.044

TABLE XI.

Solubility of Lithium Salts in Methyl Acetate.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 24.5°				
	gm.	*gm.*	*gm.*	*gm.*
Laurate	0.0027	10.22	10.22	0.026
Myristate	0.0012	9.51	9.51	0.013
Palmitate	0.0015	9.87	9.87	0.015
Stearate	0.0012	9.69	9.69	0.012

TABLE XII.

Solubility of Lithium Salts in Acetone.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 15°				
	gm.	gm.	gm.	gm.
Laurate	0.0234	7.83	7.81	0.300
Myristate	0.0322	7.82	7.79	0.413
Palmitate	0.0338	7.82	7.79	0.434
Stearate	0.0437	7.70	7.76	0.571
Temperature 25°				
Laurate	0.0293	7.82	7.79	0.376
Myristate	0.0305	6.86	6.83	0.447
Palmitate	0.0396	7.83	7.79	0.508
Stearate	0.0510	7.27	7.22	0.706
Temperature 35°				
Laurate	0.0329	7.67	7.64	0.430
Myristate	0.0385	7.71	7.67	0.502
Palmitate	0.0414	7.75	7.71	0.537
Stearate	0.0509	7.73	7.68	0.663

The magnesium salts were prepared by adding a slight excess of magnesium acetate to the warm alcoholic solutions of the fatty acids and the solution was set aside to cool. The laurate and myristate were recrystallized from hot alcohol while the palmitate and stearate were repeatedly washed with alcohol and dried.

TABLE XIII.

Solubility of Magnesium Salts in Water.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
	Temperature 15°			
	gm.	gm.	gm.	gm.
Laurate	0.0010	9.85	9.85	0.010
Myristate	0.0006	9.87	9.87	0.006
Palmitate	0.0005	9.84	9.84	0.005
Stearate	0.0003	9.85	9.85	0.003
	Temperature 25°			
Laurate	0.0007	9.85	9.85	0.007
Myristate	0.0006	9.73	9.73	0.006
Palmitate	0.0008	9.84	9.84	0.008
Stearate	0.0004	9.86	9.86	0.004
	Temperature 35°			
Laurate	0.0010	9.83	9.83	0.010
Myristate	0.0007	9.83	9.83	0.007
Palmitate	0.0006	9.83	9.83	0.006
Stearate	0.0007	9.80	9.80	0.007
	Temperature 50°			
Laurate	0.0026	9.81	9.81	0.026
Myristate	0.0014	9.79	9.79	0.014
Palmitate	0.0009	9.82	9.82	0.009
Stearate	0.0008	9.79	9.79	0.008

TABLE XIV.

Solubility of Magnesium Salts in Ethyl Alcohol (Absolute).

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
	gm.	gm.	gm.	gm.
Temperature 15°				
Laurate	0.0404	7.82	7.78	0.519
Myristate	0.0123	7.79	7.78	0.158
Palmitate	0.0028	7.83	7.83	0.034
Stearate	0.0013	7.81	7.81	0.017
Temperature 25°				
Laurate	0.0459	7.81	7.76	0.591
Myristate	0.0183	7.78	7.74	0.236
Palmitate	0.0045	7.77	7.76	0.058
Stearate	0.0018	7.77	7.77	0.023
Temperature 35°				
Laurate	0.0630	7.76	7.70	0.805
Myristate	0.0287	7.75	7.72	0.373
Palmitate	0.0066	7.74	7.74	0.085
Stearate	0.0024	7.76	7.76	0.031
Temperature 50°				
Laurate	0.0963	7.70	7.60	1.267
Myristate	0.0440	7.67	7.63	0.577
Palmitate	0.0116	7.67	7.66	0.151
Stearate	..	..	..	..

TABLE XV.

Solubility of Magnesium Salts in Methyl Alcohol.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 15°				
	gm.	gm.	gm.	gm.
Laurate	0.0863	7.93	7.87	1.095
Myristate	0.0451	7.94	7.89	0.571
Palmitate	0.0180	7.93	7.92	0.227
Stearate	0.0066	7.93	7.92	0.084
Temperature 25°				
Laurate	0.0863	7.88	7.79	1.108
Myristate	0.0594	7.84	7.78	0.763
Palmitate	0.0264	7.88	7.85	0.336
Stearate	0.0078	7.84	7.84	0.100
Temperature 51.5°				
Palmitate	0.0384	7.72	7.68	0.500
Stearate	0.0128	7.72	7.71	0.166

TABLE XVI.

Solubility of Magnesium Salts in Ether.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 25°				
	gm.	gm.	gm.	gm.
Laurate	0.0011	7.14	7.14	0.015
Myristate	0.0007	6.82	6.82	0.010
Palmitate	0.0003	7.49	7.49	0.004
Stearate	0.0002	7.47	7.47	0.003

TABLE XVII.

Solubility of Magnesium Salts in Ethyl Acetate.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 15°				
	gm.	gm.	gm.	gm.
Laurate	0.0004	8.91	8.91	0.004
Myristate	0.0004	8.89	8.89	0.004
Palmitate	0.0004	8.91	8.91	0.004
Stearate	0.0004	8.70	8.70	0.004
Temperature 35°				
Laurate	0.0010	8.74	8.74	0.011
Myristate	0.0009	8.76	8.76	0.010
Palmitate	0.0006	8.76	8.76	0.007
Stearate	0.0007	8.78	8.78	0.008
Temperature 50°				
Laurate	0.0021	8.62	8.62	0.024
Myristate	0.0018	8.61	8.61	0.021
Palmitate	0.0011	8.60	8.60	0.013
Stearate	0.0010	8.63	8.63	0.011

TABLE XVIII.

Solubility of Magnesium Salts in Acetone.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 15°				
	gm.	gm.	gm.	gm.
Laurate	0.0092	7.86	7.85	0.117
Myristate	0.0112	7.90	7.89	0.142
Palmitate	0.0131	7.89	7.89	0.166
Stearate	..	..	..	..
Temperature 25°				
Laurate	0.0096	7.81	7.80	0.123
Myristate	0.0113	7.81	7.80	0.145
Palmitate	0.0125	7.81	7.80	0.160
Stearate	0.0150	7.85	7.83	0.191

TABLE XIX.

Solubility of Magnesium Salts in Amyl Alcohol.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 15°				
	gm.	gm.	gm.	gm.
Laurate	0.0151	7.91	7.90	0.191
Myristate	0.0068	7.93	7.92	0.086
Palmitate	0.0034	7.99	7.98	0.043
Stearate	0.0011	7.89	7.89	0.014
Temperature 25°				
Laurate	0.0186	7.89	7.88	0.236
Myristate	0.0115	7.92	7.91	0.145
Palmitate	0.0052	7.94	7.93	0.066
Stearate	0.0014	7.95	7.95	0.018
Temperature 35°				
Laurate	0.1152	7.89	7.78	1.481
Myristate	0.0344	7.90	7.86	0.438
Palmitate	0.0082	7.85	7.84	0.104
Stearate	0.0031	7.88	7.88	0.039
Temperature 50°				
Laurate	0.3647	7.85	7.49	4.869
Myristate	0.1446	7.79	7.64	1.893
Palmitate	0.0205	7.81	7.79	0.263
Stearate	0.0082	7.82	7.81	0.105

TABLE XX.

Solubility of Magnesium Salts in Amyl Acetate.

	Salt.	Solution.	Solvent.	Salt in 100 gm solvent
	gm.	gm.	gm.	gm.
Temperature 15°				
Laurate	0.0100	8.39	8.38	0.119
Myristate	0.0053	8.41	8.40	0.063
Palmitate	0.0033	8.43	8.42	0.039
Stearate	0.0025	8.42	8.42	0.029
Temperature 25°				
Laurate	0.0135	8.31	8.30	0.162
Myristate	0.0061	8.35	8.34	0.073
Palmitate	0.0038	8.37	8.36	0.045
Stearate	0.0027	8.37	8.37	0.030
Temperature 34.5°				
Laurate	0.0214	8.28	8.26	0.259
Myristate	0.0087	8.29	8.28	0.105
Palmitate	0.0047	8.30	8.30	0.057
Stearate	0.0038	8.29	8.29	0.046
Temperature 50°				
Laurate	0.1553	8.16	8.01	1.939
Myristate	0.0491	8.16	8.11	0.605
Palmitate	0.0176	8.14	8.12	0.216
Stearate	0.0094	8.17	8.16	0.115

The barium salts were made by adding an alcoholic solution of $Ba(OH)_2$ to the warm alcoholic solutions of the acids and then washing the precipitates formed with hot alcohol. Even upon exercising the greatest care, a small amount of $BaCO_3$ was formed and precipitated from the alcoholic solution, but on account of the very slight solubility of the carbonate in the solvents used, no appreciable error in the solubility data is introduced from this source.

TABLE XXI.

Solubility of Barium Salts in Water.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 15.3°				
	gm.	gm.	gm.	gm.
Laurate	0.0008	9.89	9.89	0.008
Myristate	0.0007	9.90	9.90	0.007
Palmitate	0.0004	9.90	9.90	0.004
Stearate	0.0004	9.89	9.89	0.004
Temperature 50°				
Laurate	0.0011	9.77	9.77	0.011
Myristate	0.0009	8.72	8.72	0.010
Palmitate	0.0007	9.84	9.84	0.007
Stearate	0.0006	9.86	9.86	0.006

TABLE XXII.

Solubility of Barium Salts in Ethyl Alcohol (Absolute).

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 16.5°				
	gm.	gm.	gm.	gm.
Laurate	0.0008	7.82	7.82	0.010
Myristate	0.0007	7.84	7.84	0.009
Palmitate	0.0007	7.84	7.84	0.009
Stearate	0.0005	7.81	7.81	0.006
Temperature 25°				
Laurate	0.0008	7.78	7.78	0.010
Myristate	0.0009	7.79	7.79	0.011
Palmitate	0.0007	7.76	7.76	0.009
Stearate	0.0008	7.79	7.79	0.010
Temperature 35°				
Laurate	0.0010	7.72	7.72	0.013
Myristate	0.0010	7.73	7.73	0.013
Palmitate	0.0009	7.73	7.73	0.012
Stearate	0.0008	7.74	7.74	0.010
Temperature 50°				
Laurate	0.0005	7.60	7.60	0.007
Myristate	0.0003	7.67	7.67	0.004
Palmitate	0.0003	7.68	7.68	0.004
Stearate	0.0002	7.67	7.67	0.003

TABLE XXIII.

Solubility of Barium Salts in Methyl Alcohol.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 15°				
	gm.	gm.	gm.	gm.
Laurate	0.0066	7.88	7.87	0.084
Myristate	0.0045	7.91	7.91	0.057
Palmitate	0.0036	7.91	7.90	0.045
Stearate	0.0033	7.89	7.89	0.042
Temperature 25°				
Laurate	0.0075	7.84	7.83	0.096
Myristate	0.0055	7.84	7.83	0.070
Palmitate	0.0040	7.86	7.86	0.051
Stearate	0.0038	7.85	7.84	0.049
Temperature 35°				
Laurate	0.0094	7.79	7.78	0.121
Myristate	0.0068	7.79	7.78	0.087
Palmitate	0.0058	7.80	7.80	0.074
Stearate	0.0050	7.82	7.82	0.066
Temperature 50.5°				
Laurate	0.0124	7.63	7.62	0.163
Myristate	0.0083	7.71	7.70	0.108
Palmitate	0.0068	7.71	7.70	0.088
Stearate	0.0060	7.76	7.75	0.077

TABLE XXIV.

Solubility of Barium Salts in Ether (Distilled over Sodium).

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 25°				
	gm.	gm.	gm.	gm.
Laurate	0.0005	6.97	6.97	0.007
Myristate	0.0002	6.97	6.97	0.003
Palmitate	0.0001	7.00	7.00	0.001
Stearate	0.0001	6.92	6.92	0.001

TABLE XXV.

Solubility of Barium Salts in Amyl Alcohol.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 25°				
	gm.	gm.	gm.	gm.
Laurate	0.0007	7.93	7.93	0.009
Myristate	0.0007	7.72	7.72	0.009
Palmitate	0.0006	7.94	7.94	0.008
Stearate	0.0006	7.90	7.90	0.007

The lead salts were made by adding calculated amounts of lead acetate, dissolved in a mixture of alcohol and water to alcoholic solutions of the fatty acids. The stearate and palmitate precipitates were washed by decantation with boiling alcohol and finally on the filter. The laurate was washed with cold alcohol and the myristate recrystallized from boiling alcohol. The salts were all amorphous powders except the laurate which comes down crystalline.

TABLE XXVI.

Solubility of Lead Salts in Water.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 35°				
	gm.	gm.	gm.	gm.
Laurate	0.0009	9.85	9.85	0.009
Myristate	0.0005	9.85	9.85	0.005
Palmitate	0.0005	9.85	9.85	0.005
Stearate	0.0005	9.85	9.85	0.005
Temperature 50°				
Laurate	0.0007	9.82	9.82	0.007
Myristate	0.0006	9.81	9.81	0.006
Palmitate	0.0007	9.84	9.84	0.007
Stearate	0.0006	9.82	9.82	0.006

TABLE XXVII.

Solubility of Lead Salts in Ethyl Alcohol (Absolute).

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 25°				
	gm.	gm.	gm.	gm.
Laurate	0.0007	7.80	7.80	0.009
Myristate	0.0003	7.80	7.80	0.004
Palmitate	0.0000	7.80	7.80	0.000
Stearate	0.0000	7.78	7.78	0.000
Temperature 35°				
Laurate	0.0025	7.74	7.74	0.032
Myristate	0.0003	7.73	7.73	0.004
Palmitate	0.0001	7.74	7.74	0.001
Stearate	0.0001	7.71	7.71	0.001
Temperature 50°				
Laurate	0.0202	7.67	7.64	0.264
Myristate	0.0040	7.66	7.66	0.052
Palmitate	0.0009	7.70	7.70	0.012
Stearate	0.0003	7.66	7.66	0.004

TABLE XXVIII.

Solubility of Lead Salts in Methyl Alcohol.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 15.5°				
	gm.	gm.	gm.	gm.
Laurate	0.0048	7.91	7.90	0.061
Myristate	0.0044	7.87	7.87	0.056
Palmitate	0.0040	7.90	7.90	0.051
Stearate	0.0031	7.90	7.90	0.039
Temperature 25°				
Laurate	0.0075	7.85	7.84	0.096
Myristate	0.0061	7.85	7.85	0.078
Palmitate	0.0054	7.87	7.86	0.069
Stearate	0.0040	7.82	7.82	0.051
Temperature 35°				
Laurate	0.0088	7.79	7.78	0.113
Myristate	0.0064	7.81	7.81	0.082
Palmitate	0.0059	7.79	7.78	0.076
Stearate	0.0048	7.81	7.81	0.062
Temperature 50°				
Laurate	0.0216	7.73	7.71	0.280
Myristate	0.0092	7.70	7.69	0.119
Palmitate	0.0072	7.72	7.71	0.093
Stearate	0.0064	7.73	7.73	0.083

TABLE XXIX.

Solubility of Lead Salts in Ether (Distilled over Sodium).

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 14.5°				
	gm.	gm.	gm.	gm.
Laurate	0.0008	7.04	7.04	0.010
Myristate	0.0009	6.96	6.96	0.013
Palmitate	0.0007	7.05	7.05	0.010
Stearate	0.0005	7.04	7.04	0.007

TABLE XXX.

Solubility of Lead Salts in Ethyl Acetate.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 14°				
	gm.	gm.	gm.	gm.
Laurate	0.0015	8.89	8.89	0.017
Myristate	0.0009	8.93	8.93	0.010
Palmitate	0.0008	8.94	8.94	0.009
Stearate	0.0006	8.93	8.93	0.007
Temperature 35.5°				
Laurate	0.0031	8.75	8.75	0.035
Myristate	0.0013	8.76	8.76	0.015
Palmitate	0.0008	8.76	8.76	0.009
Stearate	0.0007	8.74	8.74	0.008
Temperature 50°				
Laurate	0.0182	8.68	8.66	0.210
Myristate	0.0067	8.67	8.67	0.077
Palmitate	0.0029	8.66	8.65	0.033
Stearate	0.0017	8.64	8.64	0.020

TABLE XXXI.

Solubility of Lead Salts in Benzene.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 15°				
	gm.	gm.	gm.	gm.
Laurate	0.0010	8.71	8.71	0.011
Myristate	0.0009	8.71	8.71	0.010
Palmitate	0.0008	8.71	8.71	0.009
Stearate	0.0007	8.69	8.69	0.008

The silver salts were made by adding a calculated amount of ammoniacal silver nitrate dissolved in alcohol to alcoholic solutions of the acids. The white curdy precipitates resulting were extracted with hot 95 per cent alcohol, then washed on filters and dried.

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TABLE XXXII.

Solubility of Silver Salts in Water.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 35°				
	gm.	*gm.*	*gm.*	*gm.*
Laurate	..	..	..	..
Myristate	0.0006	9.23	9.23	0.007
Palmitate	0.0004	9.85	9.85	0.004
Stearate	0.0004	9.85	9.85	0.004
Temperature 50°				
Laurate	..	..	..	..
Myristate	0.0007	9.83	9.83	0.007
Palmitate	0.0006	9.80	9.80	0.006
Stearate	0.0004	9.82	9.82	0.004

TABLE XXXIII.

Solubility of Silver Salts in Ethyl Alcohol (Absolute).

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 25°				
	gm.	*gm.*	*gm.*	*gm.*
Laurate	0.0007	7.78	7.78	0.009
Myristate	0.0006	7.76	7.76	0.008
Palmitate	0.0005	7.77	7.77	0.007
Stearate	0.0003	7.77	7.77	0.007
Temperature 50°				
Laurate	0.0007	7.68	7.68	0.009
Myristate	0.0006	7.67	7.67	0.008
Palmitate	0.0005	7.67	7.67	0.007
Stearate	0.0005	7.67	7.67	0.007

TABLE XXXIV.

Solubility of Silver Salts in Methyl Alcohol.

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 15°				
	gm.	gm.	gm.	gm.
Laurate	0.0058	7.88	7.87	0.074
Myristate	0.0050	7.89	7.89	0.063
Palmitate	0.0048	7.91	7.90	0.060
Stearate	0.0040	7.91	7.91	0.051
Temperature 25°				
Laurate	0.0056	7.84	7.84	0.072
Myristate	0.0053	7.87	7.86	0.067
Palmitate	0.0046	7.88	7.88	0.059
Stearate	0.0041	7.87	7.87	0.052
Temperature 35°				
Laurate	0.0061	7.78	7.77	0.078
Myristate	0.0055	7.80	7.80	0.071
Palmitate	0.0043	7.79	7.79	0.062
Stearate	0.0043	7.80	7.79	0.055
Temperature 50°				
Laurate	0.0064	7.70	7.70	0.083
Myristate	0.0056	7.72	7.71	0.073
Palmitate	0.0051	7.71	7.71	0.066
Stearate	0.0046	7.71	7.71	0.060

TABLE XXXV.

Solubility of Silver Salts in Ether (Distilled over Sodium).

	Salt.	Solution.	Solvent.	Salt in 100 gm. solvent.
Temperature 15°				
	gm.	gm.	gm.	gm.
Laurate	0.0007	6.99	6.99	0.010
Myristate	0.0006	7.02	7.02	0.009
Palmitate	0.0006	6.75	6.75	0.009
Stearate	0.0005	7.04	7.04	0.007

CONCLUSIONS.

From the above tables it is seen that the solubility of all the salts of the four fatty acids in the various solvents tried is only slight, but that considerable differences are found not only among the several salts in the same solvent, but also for the same salts in the different solvents.

The solubility in any case rarely exceeds 1 per cent, but was found to vary between 6 per cent and virtual insolubility. Methyl alcohol was found to be the best general solvent for this class of substances.

The lithium salts were found to be about three times as soluble in methyl alcohol and acetone as the magnesium salts, while the latter are more soluble in ethyl alcohol than the former.

It is also seen that the lithium salts are a great deal more soluble in water than the magnesium salts, but the difference is not a constant ratio for the different temperatures.

The beryllium salts of the fatty acids were made, but contrary to expectations we found that the basic salts, rather than the normal, were formed.